PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-000594
(43)Date of publication of application : 11.01.1994

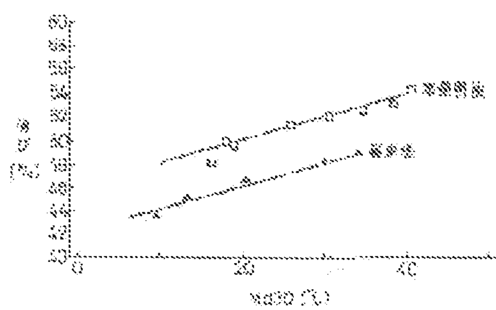
(51)Int.Cl. B22D 11/06
B22D 11/00

(21)Application number : 04-181550
(22)Date of filing : 17.06.1992

(71)Applicant : NIPPON STEEL CORP
(72)Inventor : FUKUDA YOSHIMORI
TANAKA SHIGENORI
TERAOKA SHINICHI
KIRIHARA MASAFUMI

(54) PRODUCTION OF CR-NI SERIES STAINLESS STEEL STRIP HAVING EXCELLENT ELONGATION CHARACTERISTIC

(57)Abstract:
PURPOSE: To provide a method for producing a Cr-Ni series stainless steel strip by a twin roll type continuous casting method.
CONSTITUTION: This producing method is constituted so that the molten Cr-Ni Series stainless steel containing 4 0.003& S concn., ≤0.003% Al concn., and ≤30% Al2O3 and CaO-Al2O3-MnO-SiO2-MgO series inclusion mainly containing MnO and SiO2 is cast into the cast strip by the twin roll type continuous casting method and this cast strip is cold-rolled.



LEGAL STATUS
[Date of request for examination] 02.02.1998
[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3098109
[Date of registration]	11.08.2000
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	11.08.2004

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] It is 0.003% or less of S concentration of molten steel, and 0.003% or less of aluminum concentration, and is aluminum 2O3 in molten steel. It is MnO and SiO2 in 30% or less of contents. The manufacture approach of Cr-nickel system stainless steel sheet metal which was excellent in the elongation property characterized by casting the Cr-nickel system stainless steel molten steel containing the CaO-aluminum2 O3-MnO-SiO2-MgO system inclusion used as a principal component to a thin band-like cast piece by the congruence roll type continuous casting process, and cold-rolling this cast piece.
[Claim 2] Said Cr-nickel system stainless steel is the following type. 1 Approach according to claim 1 characterized by having the presentation in the range whose Md30 defined is 0-50 degrees C.
Md30 = 413-462(C+N)-9.2Si-8.1Mn-13.7Cr-18.5Mo-9.1(Ni+Cu)... 1

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the approach of manufacturing Cr-nickel system stainless steel sheet metal by the congruence roll type continuous casting process. A congruence roll type continuous casting process is the continuous casting approach which pour a metal molten metal into the slag trap constituted by the side weir which carries out the seal of the cooling roller and its both-ends side of the pair which carried out parallel arrangement, make coagulation husks generate in the shape of [of both cooling rollers] a periphery side, respectively, and coagulation husks are made to coalesce near the recently contact position (the so-called "kissing point") of both the rotating cooling rollers, and is sent out as a thin band-like cast piece of one.
[0002] The thin band-like cast piece cast by the congruence roll type continuous casting process is several mm (usually about 1-6mm) in thickness, can be cold-rolled without passing through hot rolling, and can manufacture a sheet metal product. therefore, compared with the manufacture approach (a slab cast piece / hot rolling process) cold-rolled after the continuous casting using oscillating mold etc. casts the cast piece as slab for hot rolling of several 100mm angle and hot-rolling this, productive efficiency and cost are markedly alike, and become advantageous.
[0003]
[Description of the Prior Art] The Cr-nickel system stainless steel sheet metal by cold rolling is a high product of added value which various cold-forming processings are performed and is widely used as corrosion-resistant structure material and a sheathing material industrial and for home use, and it is expected by applying a congruence roll type continuous casting process to the manufacture that high economic effects will be acquired.
[0004] Since casting of the thin band-like cast piece by congruence roll type continuous casting serves as remarkable rapid solidification compared with the continuous casting of the slab cast piece of a large cross section, its solidification structure is detailed, and inclusion also carries out an a large number deposit minutely. In order to secure the elongation value which has direct effect on the cold-forming nature of sheet metal, crystal grain fully needs to make it big and rough. However, when MnS system inclusion and supersaturated S were recognizing a large number existence minutely especially, the grain growth at the time of the recrystallization at the time of cold-rolling and annealing a thin band-like cast piece was controlled, and there was a problem that a fall and dispersion of the elongation of a cold-rolled product were large.
[0005]
[Problem(s) to be Solved by the Invention] This invention aims at offering the approach of it being stabilized and manufacturing the Cr-nickel system stainless steel sheet metal which was excellent in the elongation property with the congruence roll type continuous casting process.
[0006]
[Means for Solving the Problem] According to this invention, the above-mentioned purposes are 0.003% or less of S concentration of molten steel, and 0.003% or less of aluminum concentration. And it is aluminum 2O3 in molten steel. It is MnO-SiO2 in 30% or less of contents. The Cr-nickel system stainless steel molten steel containing the CaO-aluminum2 O3-MnO-SiO2-MgO system inclusion used as a principal component is cast to a thin

band-like cast piece by the congruence roll type continuous casting process. It is attained by the manufacture approach of Cr-nickel system stainless steel sheet metal which was excellent in the elongation property characterized by cold-rolling this cast piece.
[0007] The approach of this invention is the following type. 1 It is advantageous especially if Md30 defined applies to the Cr-nickel system stainless steel which has the presentation in the range which is 0-50 degrees C.
Md30 = 413-462(C+N)-9.2Si-8.1Mn-13.7Cr-18.5Mo-9.1 (nickel+Cu) ... 1 [0008]
[Function] If a Cr-nickel system stainless steel thin band-like cast piece is cast in a congruence roll type continuous casting process, since the cooling rate is as quick as 2000 degrees C / sec extent, detailed MnS deposits in the whole cast piece, or S exists in supersaturation. It turned out that this bars the recrystallization gamma grain growth at the time of cold-rolling and annealing. then, the big and rough deposit of the MnS is preferentially carried out by the cast piece, and recrystallization grain growth is barred -- detailed -- it is effective to decrease the number of MnS(s).
[0009] On the other hand, it became clear that MnS of a cast piece deposited considering Mn silicate as a nucleus. Therefore, it is effective to secure existence of Mn silicate into a cast piece for carrying out that it is easy to carry out the big and rough deposit of the MnS. Furthermore, it became clear that the presentation of inclusion could be optimized by adjustment of the basicity at the time of refinement. Basicity is the CaO % of the weight in a slag, and SiO2 here. A ratio (%CaO/%SiO2) with weight % shows. It became clear molten steel S concentration at that time that to consider as 0.003% or less is required in molten steel aluminum concentration 0.003% or less. If S concentration increases more than 0.003%, during casting, big and rough MnS will not fully deposit, but a detailed thing will increase, and elongation will fall. When aluminum concentration increases more than 0.003%, the presentation of inclusion is aluminum 2O3. 30% or more of CaO-aluminum2 O3-MnO-SiO2-MgO system, or MgO-aluminum 2O3 It becomes a system and is inadequate as a deposit nucleus of MnS.
[0010] Conventionally, the ingot of Cr-nickel system stainless steel which carries out congruence roll type continuous casting is performed by electric furnace dissolution-AOD refinement (EF-AOD process) or the dissolution (the VIM method) by the vacuum induction furnace. In the case of EF-AOD process, the basicity at the time of refinement is low at 1.6 to about two, and inclusion is aluminum 2O3. Concentration is MnO-SiO2 at 30% or less. Although it is the CaO-aluminum2O3-MnO-SiO2-MgO system presentation used as a principal component, molten steel S concentration is comparatively as high as 50-80 ppm. In this case, although much Mn silicate used as the deposit nucleus of MnS exists, since S concentration is high, MnS carries out an a large number deposit minutely after all, and the elongation of a cold-rolled product falls.
[0011] On the other hand, in the case of the VIM method, about three to four high basicity refinement is possible, S concentration can be reduced to 10-30 ppm, but inclusion serves as an aluminum2 O3-MgO system presentation. In this case, although S concentration is low, since Mn silicate which can serve as a nucleus of a MnS deposit does not exist and S exists in MnS detailed after all and supersaturation, the grain growth at the time of recrystallization of the difference cold-rolled and annealed will be controlled, and the elongation of a cold-rolled product falls.
[0012] In order to realize the inside S of the molten steel specified by this invention and aluminum concentration, and an inclusion presentation, it is inadequate with the above-mentioned conventional ingoting method. For example, the inclusion presentation of this invention can be acquired by in the case of the VIM method, carrying out a waste, after carrying out desulfurization processing with high basicity first, and adjusting basicity less than [not high basicity called 3-4 but conventional rather lower 2.5 or conventional it].

Moreover, in the case of EF-AOD process, it is necessary to consider as EF-PIM-AOD which performs powder injection refinement (PIM) in front of after [AOD] EF, or to reduce S to 0.003% or less using a double slag in AOD.
[0013] Below, an example explains this invention further at a detail.
[0014]
[Example] the Cr-nickel system stainless steel molten steel of the presentation shown in Table 1 -- a congruence roll type continuous casting process -- a thin band-like cast piece with a thickness of 3mm -- casting -- this -- cold rolling -- and bright annealing was carried out and the sheet metal product with a thickness of 0.6mm was manufactured. Measurement of elongation by the tension test and deposit distribution of MnS by CMA (Computer-aided Micro Analyzer: element wafer scanner) were measured about each product plate.
[0015] Table 2 -- method of ingoting after EF, and formula from a presentation 1 The presentation of Md30 value computed, slag basicity, and inclusion, the propriety (O ** and x -- unsuitable) as a MnS nucleus, and the elongation (%) of product sheet metal are shown.
[0016]
[Table 1]

No	C	Si	Mn	P	S	Cr	Ni	Cu	Mo	Al	N	O
A	0.050	0.52	0.87	0.016	0.002	18.21	8.20	0.23	0.14	0.002	0.0244	0.0056
B	0.023	0.48	1.02	0.024	0.003	18.42	8.15	0.12	0.10	0.002	0.0352	0.0049
C	0.056	0.46	0.93	0.027	0.001	18.31	8.45	0.04	0.12	0.001	0.0340	0.0057
D	0.054	0.41	0.81	0.016	0.002	18.15	8.11	0.01	0.01	0.003	0.0285	0.0061
E	0.065	0.49	0.98	0.013	0.001	18.62	8.56	0.10	0.05	0.002	0.0348	0.0086
F	0.045	0.62	0.87	0.021	0.002	18.65	8.49	0.10	0.19	0.001	0.0451	0.0049
G	0.040	0.54	0.82	0.016	0.002	18.21	8.40	0.12	1.00	0.002	0.0326	0.0048
H	0.035	0.55	1.20	0.018	0.003	18.38	8.91	0.11	0.06	0.001	0.0278	0.0068
I	0.069	0.548	1.05	0.016	0.006	18.56	8.84	0.11	0.01	0.003	0.0321	0.0075
J	0.045	0.52	0.95	0.018	0.003	18.54	8.35	0.18	0.12	0.003	0.0270	0.0058
K	0.059	0.06	0.91	0.015	0.007	18.97	8.71	0.01	0.10	0.003	0.0280	0.0069
L	0.078	0.52	0.95	0.018	0.012	18.54	8.52	0.18	0.12	0.005	0.0350	0.0049
M	0.038	0.06	0.91	0.015	0.011	18.97	8.20	0.01	0.10	0.004	0.0298	0.0085

[0017]
[Table 2]

		製造方法	鋳造速度 (m/min)	板厚 (mm)	Md_{30}	塩基度	介在物組成(重量%) CaO	SiO_2	Al_2O_3	MnO	Cr_2O_3	MgO	MnS核	材質(%) (伸び)
本発明例	A	VIM	105	2.0	36.6	1.50	11.7	34.7	16.3	31.5	1.5	4.3	○	52.5
	B	VIM	40	4.0	40.7	0.90	10.8	36.3	14.5	33.4	1.2	3.8	○	54.2
	C	PIM-AOD	30	4.5	25.9	1.70	17.7	32.7	16.8	27.5	0.8	4.5	○	51.3
	D	PIM-AOD	130	1.6	38.6	1.15	15.6	28.3	14.1	35.6	1.6	4.8	○	53.0
	E	PIM-AOD	80	2.3	16.2	1.00	11.3	29.0	15.7	38.2	1.7	4.1	○	48.2
	F	PIM-AOD	80	2.3	18.0	1.85	11.1	31.0	23.4	30.4	0.4	3.7	○	49.8
	G	PIM-AOD	105	2.0	18.9	1.95	11.3	31.8	26.8	27.3	0.2	2.6	○	49.5
	H	AOD ダブルスラグ	40	4.0	30.6	1.60	18.0	32.4	15.7	28.6	1.2	4.1	○	52.0
比較例	I	VIM	105	2.0	13.2	3.5	0	-	78.5	-	-	21.5	×	45.3
	J	VIM	40	4.0	30.0	3.3	0	-	72.3	-	-	27.7	×	48.2
	K	AOD	80	2.3	20.3	1.7	22.4	31.8	14.3	27.3	0.5	3.7	○	46.8
	L	AOD	105	2.0	0.5	2.6	5.6	31.3	32.7	14.3	0.8	15.9	×	43.8
	M	AOD	105	2.0	34.0	1.4	14.5	34.2	13.8	32.3	1.1	4.1	○	49.0

[0018] In Table 1 and 2, A-H is an example by this invention, and I-M is an example of a comparison. the comparison material I -- as for the amount [of S], amount of aluminum and inclusion presentation, and comparison material M, in the amount [of S], and comparison material L, the amount of S and the amount of aluminum are not filling [the amount / of S / and inclusion presentation, and comparison material J / the inclusion presentation and comparison material K] the range of this invention. The relation between Md30 value and

elongation is shown in drawing 1 . In same Md30 value, it turns out that elongation of sheet metal by this invention is improving 3 to 4% compared with the comparison material by the conventional method.

[0019] The MnS deposit distribution by CMA is shown in drawing 2 (a) and (b) about H material (52% of elongation) of this invention, and J material (48.2% of elongation) of the example of a comparison. In CMA, MnS of the dimension of 0.5 micrometers or more of circles is detectable. Although H material of this invention is a presentation (Md30 value) almost equivalent to J material of the example of a comparison, there is much big and rough MnS, and if it thinks in adversative conjunction, there is little detailed MnS which checks grain growth. For this, the inclusion presentation of J material is aluminum 2O3 to the inclusion presentation of H material being Mn silicate system. It is because it is a system.

[0020] As shown in drawing 3 , as for the inside MnS of steel, it turns out that it deposits considering Mn silicate as a nucleus. At least each part depends the presentation of A, B, and C on the thin film analysis by the scanning electron microscope. The effect of the slag basicity (CaO/SiO2 ratio) exerted on an inclusion presentation at drawing 4 is shown. An inclusion presentation is controllable by adjustment of basicity using this relation. In the range of basicity 0.5-2.5, an inclusion presentation suitable as a MnS deposit nucleus is acquired. If basicity becomes smaller than 0.5, the oxygen density in molten steel will become high, the cleanliness of a cast piece will worsen, and aggravation and a rust resistant fall of the plating nature by inclusion reason take place. If basicity becomes larger than 2.5, inclusion will serve as an aluminum2 O3-MgO system presentation, and will become unsuitable as a deposit nucleus of MnS.

[0021] Temperature transition on the front face of a cast piece in casting rate 40 m/min and 105 m/min is shown in drawing 5 . It is thought that the deposit of MnS becomes still more advantageous so that time amount 900 degrees C or more is long.

[0022]

[Effect of the Invention] As explained above, according to this invention, by forming the reduction in C, and low N conventionally, and depositing MnS big and rough by the reduction in S, and rationalization of an inclusion presentation as compared with the approach which adjusted and cast Md30 of an outline also at the time of the rapid solidification in congruence roll type continuous casting, cheaply, it is stabilized and the Cr-nickel system stainless steel sheet metal which was excellent in the high elongation property as compared with the conventional method can be manufactured.

[Translation done.]

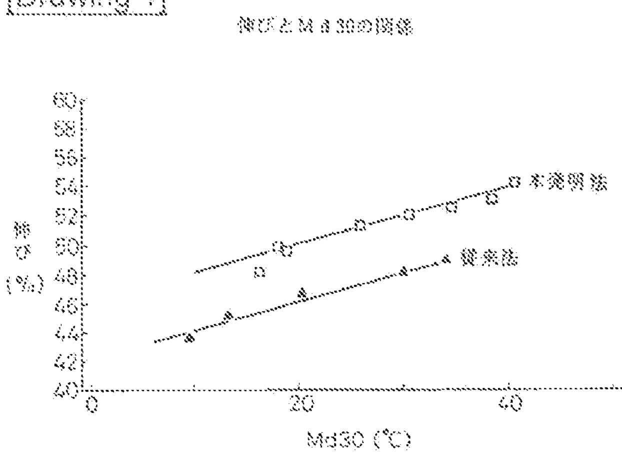
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the graph which shows the relation between Md30 value and elongation about this invention material and comparison material.
[Drawing 2] It is as a result of [which shows MnS deposit distribution of this invention material (a) and comparison material (b)] CMA measurement.
[Drawing 3] It is the electron microscope photograph in which the deposit gestalt in [MnS] steel is shown.
[Drawing 4] It is the graph which shows the relation between slag basicity and an inclusion presentation.
[Drawing 5] It is the graph which shows temperature transition on the front face of a cast piece.

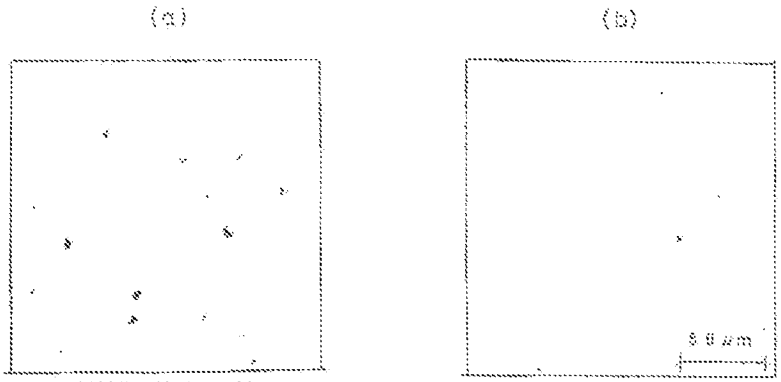
[Translation done.]

DRAWINGS

[Drawing 1]



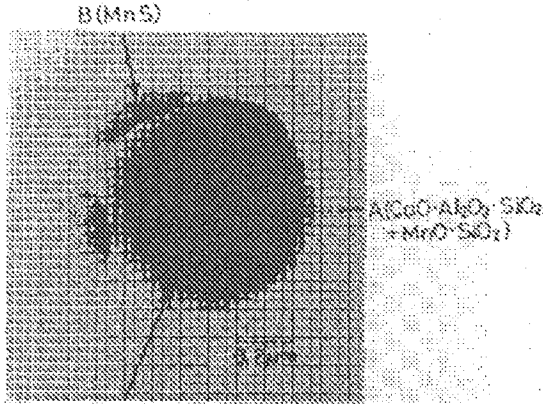
[Drawing 2]



試料B（伸び52.0%）　試料J（伸び48.2%）

鋳片のMnS析出分布（CMA測定結果）
測定条件　ビーム1μm
照射電流1μA
照射時間30msec
測定視野400×400μm²

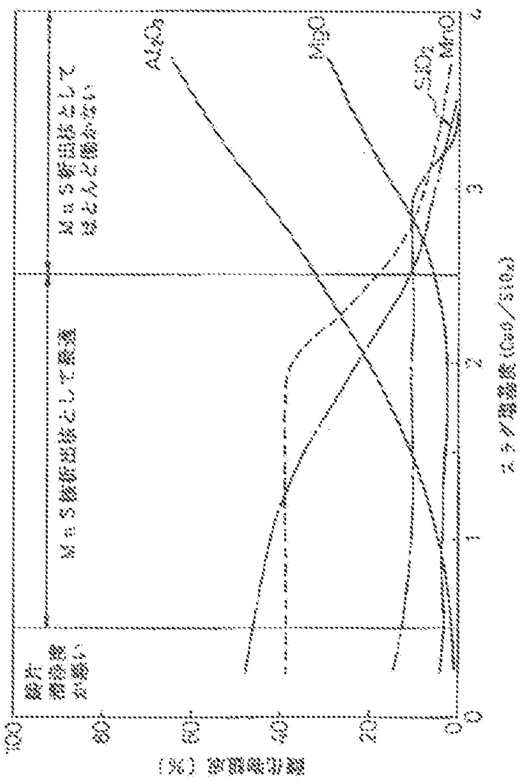
[Drawing 3]



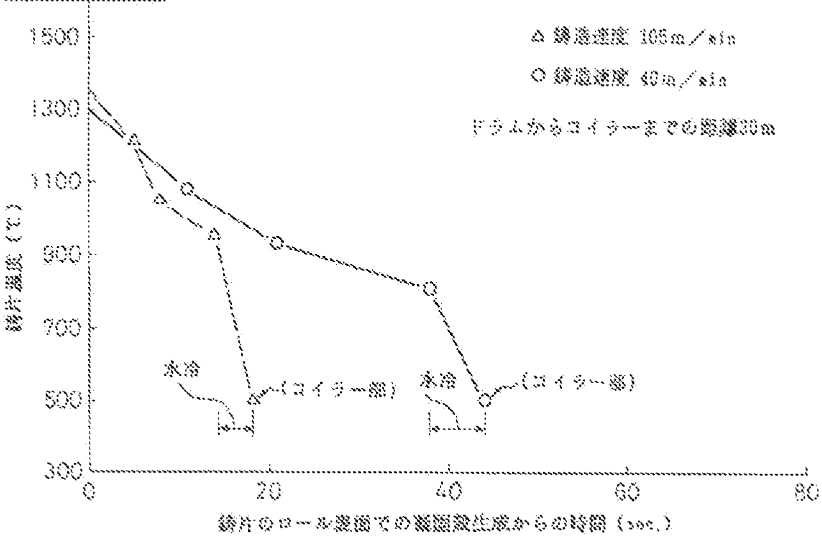
写　真

[Drawing 4]

MnS析出核組成におよぼすスラグ塩基度の影響



[Drawing 5]



[Translation done.]

(19)日本国特許庁（ＪＰ）　　(12) 公開特許公報（Ａ）　　(11)特許出願公開番号

特開平6－594

(43)公開日　平成6年(1994)1月11日

(51)Int.Cl.^{5}	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｂ２２Ｄ　11/06	３３０　Ｂ	7362－4Ｅ		
11/06	Ｂ	7362－4Ｅ		

審査請求　未請求　請求項の数２（全　７　頁）

(21)出願番号　特願平4－181550

(22)出願日　平成4年(1992)6月17日

(71)出願人　000006655
新日本製鐵株式会社
東京都千代田区大手町２丁目６番３号

(72)発明者　福田　義盛
山口県光市大字島田3434番地　新日本製鐵株式会社光製鐵所内

(72)発明者　田中　重典
山口県光市大字島田3434番地　新日本製鐵株式会社光製鐵所内

(72)発明者　寺岡　慎一
山口県光市大字島田3434番地　新日本製鐵株式会社光製鐵所内

(74)代理人　弁理士　青木　朗　（外４名）

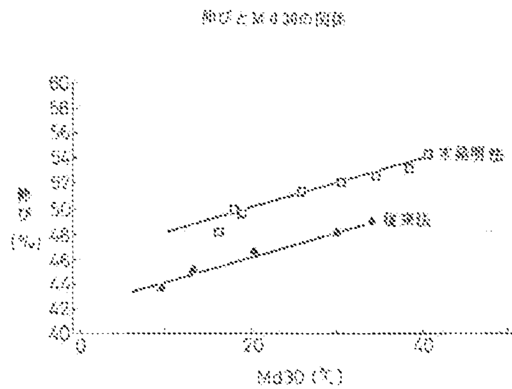
最終頁に続く

(54)【発明の名称】　伸び特性の優れたＣｒ－Ｎｉ系ステンレス鋼薄板の製造方法

(57)【要約】

【目的】双ロール式連続鋳造法によりＣｒ－Ｎｉ系ステンレス鋼薄板を製造する方法に関し、ＭｎＳを粗大析出させたことにより伸び特性の優れたＣｒ－Ｎｉ系ステンレス鋼薄板を製造する方法を提供することを目的とする。

【構成】溶鋼のＳ濃度０．００３％以下、Ａｌ濃度０．００３％以下であり、且つ溶鋼中にAl_2O_3含有量３０％以下でＭｎＯとSiO_2を主成分とする$CaO-Al_2O_3-MnO-SiO_2-MgO$系介在物を含むＣｒ－Ｎｉ系ステンレス鋼溶鋼を双ロール式連続鋳造法により薄帯状鋳片に鋳造し、この鋳片を冷間圧延するように構成する。



1　　2

【特許請求の範囲】

【請求項1】　溶鋼のS濃度0．003%以下、Al濃度0．003%以下であり、且つ溶鋼中にAl_2O_3含有量30%以下でMnOとSiO_2を主成分とするCaO−Al_2O_3−MnO−SiO_2−MgO系介在物を含むCr−Ni系ステンレス鋼溶鋼を双ロール式連続鋳造法により薄帯状鋳片に鋳造し、この鋳片を冷間圧延することを特徴とする伸び特性の優れたCr−Ni系ステンレス鋼薄板の製造方法。

【請求項2】　前記Cr−Ni系ステンレス鋼が、下記式1で定義されるMd30が0〜50℃の範囲にある組成を有することを特徴とする請求項1記載の方法。

Md30 = 413-462(C+N)-9.2Si-8.1Mn-13.7Cr-18.5Mo-9.1(Ni+Cu)... 1

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、双ロール式連続鋳造法によりCr−Ni系ステンレス鋼薄板を製造する方法に関する。双ロール式連続鋳造法は、平行配置した一対の冷却ロールとその両端面をシールするサイド堰とによって構成した湯溜まり部に金属溶湯を注入し、両冷却ロールの円周面状にそれぞれ凝固殻を生成させ、回転する両冷却ロールの最近接位置（いわゆる「キッシングポイント」）付近で凝固殻同士を合体させて一体の薄帯状鋳片として送出する連続鋳造方法である。

【0002】双ロール式連続鋳造法により鋳造される薄帯状鋳片は、厚さ数mm（通常1〜6mm程度）であり、熱間圧延を経ずに冷間圧延を行って薄板製品を製造することができる。そのため、振動鋳型等を用いる連続鋳造により数100mm角の熱間圧延用スラブとしての鋳片を鋳造し、これを熱間圧延してから冷間圧延する製造方法（スラブ鋳片／熱間圧延プロセス）に比べて、生産効率およびコストが格段に有利になる。

【0003】

【従来の技術】冷間圧延によるCr−Ni系ステンレス鋼薄板は、種々の冷間成形加工を施されて産業用および家庭用の耐食性構造材および外装材として広く用いられている付加価値の高い製品であり、その製造に双ロール式連続鋳造法を適用することにより高い経済効果が得られることが期待される。

【0004】双ロール式連続鋳造による薄帯状鋳片の鋳造は、大断面のスラブ鋳片の連続鋳造に比べて著しい急冷凝固となるため凝固組織が微細であり、介在物も微細に多数析出する。薄板の冷間成形性に直接影響を及ぼす伸び値を確保するためには、結晶粒が十分に粗大化している必要がある。しかし、特にMnS系介在物や過飽和したSが微細に多数存在していると、薄帯状鋳片を冷間圧延・焼鈍した際の再結晶時の結晶粒成長が抑制され、冷延製品の伸びの低下やばらつきが大きいという問題があった。

【0005】

【発明が解決しようとする課題】本発明は、双ロール式連続鋳造法により伸び特性の優れたCr−Ni系ステンレス鋼薄板を安定して製造する方法を提供することを目的とする。

【0006】

【課題を解決するための手段】上記の目的は、本発明によれば、溶鋼のS濃度0．003%以下、Al濃度0．003%以下であり、且つ溶鋼中にAl_2O_3含有量30%以下でMnO−SiO_2を主成分とするCaO−Al_2O_3−MnO−SiO_2−MgO系介在物を含むCr−Ni系ステンレス鋼溶鋼を双ロール式連続鋳造法により薄帯状鋳片に鋳造し、この鋳片を冷間圧延することを特徴とする伸び特性の優れたCr−Ni系ステンレス鋼薄板の製造方法によって達成される。

【0007】本発明の方法は、下記式1で定義されるMd30が0〜50℃の範囲にある組成を有するCr−Ni系ステンレス鋼に適用すると特に有利である。

Md30 = 413-462(C+N)-9.2Si-8.1Mn-13.7Cr-18.5Mo-9.1(Ni+Cu)... 1

【0008】

【作用】双ロール式連続鋳造法でCr−Ni系ステンレス鋼薄帯状鋳片を鋳造すると、冷却速度が2000℃/sec程度と速いため微細なMnSが鋳片全体に析出しまたはSが過飽和に存在する。これが冷延・焼鈍時の再結晶γ粒の成長を妨げることが分かった。そこで、鋳片でMnSを優先的に粗大析出させ、再結晶粒成長を妨げる微細MnSの数を減少させることが有効である。

【0009】一方、鋳片のMnSはMnシリケートを核として析出していることが判明した。従って、MnSを粗大析出し易くするには鋳片中にMnシリケートの存在を確保することが有効である。更に、介在物の組成は精錬時の塩基度の調整により最適化できることが判明した。ここで塩基度はスラグ中のCaO重量%とSiO_2重量%との比率（%CaO／%SiO_2）で示す。その際、溶鋼S濃度を0．003%以下、溶鋼Al濃度を0．003%以下とすることが必要であることが判明した。S濃度が0．003%より多くなると、鋳造中に粗大なMnSが十分に析出せず微細なものが多くなり、伸びが低下する。Al濃度が0．003%より多くなると、介在物の組成がAl_2O_3が30%以上のCaO−Al_2O_3−MnO−SiO_2−MgO系か、またはMgO−Al_2O_3系となり、MnSの析出核として不十分である。

【0010】従来、双ロール式連続鋳造するCr−Ni系ステンレス鋼の溶製は、電気炉溶解−AOD精錬（EF−AOD法）または真空誘導炉による溶解（VIM法）によって行われている。EF−AOD法の場合、精錬時の塩基度は1．6から2程度で低く、介在物はAl_2O_3濃度が30%以下でMnO−SiO_2を主成分と

する$CaO-Al_2O_3-MnO-SiO_2-MgO$系組成であるが、溶鋼S濃度は50～80ppmと比較的高い。この場合、MnSの析出核となるMnシリケートが多数存在しているが、S濃度が高いため結局MnSが微細に多数析出してしまい、冷延製品の伸びが低下する。

【0011】一方、VIM法の場合、3から4程度の高塩基度精錬が可能であり、S濃度を10～30ppmに低減できるが、介在物はAl_2O_3-MgO系組成となる。この場合、S濃度は低いが、MnS析出の核となり得るMnシリケートが存在しないため、結局微細なMnSや過飽和にSが存在するため、冷間圧延・焼鈍した素巣の再結晶時の結晶粒成長が抑制されてしまい、冷延製品の伸びが低下する。

【0012】本発明で規定した溶鋼中SおよびAl濃度と介在物組成とを実現するには、上記従来の溶製法のままでは不十分である。例えばVIM法の場合に、先ず高塩基度で脱硫処理をした後に排滓して、塩基度を従来の3～4という高塩基度ではなくむしろ低めの2．5あるいはそれ以下に調整することにより、本発明の介在物組成を得ることができる。また、EF－AOD法の場合には、EF後AOD前にパウダーインジェクション精錬（PIM）を行うEF－PIM－AODとするか、あるいはAODにおいてダブルスラグを用いてSを0．003％以下に低減させることが必要になる。

【0013】以下に、実施例によって本発明を更に詳細に説明する。

【0014】

【実施例】表1に示す組成のCr－Ni系ステンレス鋼溶鋼を双ロール式連続鋳造法により厚さ3mmの薄帯状鋳片に鋳造し、これを冷間圧延および光輝焼鈍して厚さ0．6mmの薄板製品を製造した。各製品板について引張試験による伸びの測定およびCMA（Computer-aided Micro Analyzer：元素マッピング装置）によるMnSの析出分布の測定を行った。

【0015】表2に、EF以降の溶製法、組成から式1により算出されるMd30値、スラグ塩基度、介在物の組成およびMnS核としての適否（○適、×不適）、および製品薄板の伸び（%）を示す。

【0016】

【表1】

No	C	Si	Mn	P	S	Cr	Ni	Cu	Mo	Al	N	O
A	0.050	0.52	0.87	0.016	0.002	18.21	8.20	0.23	0.14	0.002	0.0244	0.0056
B	0.023	0.48	1.02	0.024	0.003	18.42	8.15	0.12	0.10	0.002	0.0352	0.0049
C	0.056	0.46	0.93	0.027	0.001	18.31	8.45	0.04	0.12	0.001	0.0340	0.0057
D	0.054	0.41	0.81	0.016	0.002	18.15	8.11	0.01	0.01	0.003	0.0285	0.0061
E	0.065	0.49	0.88	0.013	0.001	18.62	8.56	0.10	0.05	0.002	0.0348	0.0086
F	0.045	0.62	0.87	0.021	0.002	18.65	8.49	0.10	0.19	0.001	0.0451	0.0049
G	0.040	0.54	0.82	0.016	0.002	18.21	8.40	0.12	1.00	0.002	0.0326	0.0048
H	0.035	0.55	1.20	0.018	0.003	18.38	8.91	0.11	0.06	0.001	0.0278	0.0068
I	0.069	0.548	1.05	0.016	0.006	18.56	8.84	0.11	0.01	0.003	0.0321	0.0075
J	0.045	0.52	0.95	0.018	0.003	18.54	8.35	0.18	0.12	0.003	0.0270	0.0058
K	0.059	0.06	0.91	0.015	0.007	18.97	8.71	0.01	0.10	0.003	0.0280	0.0069
L	0.078	0.53	0.95	0.018	0.012	18.54	8.52	0.18	0.12	0.005	0.0350	0.0049
M	0.038	0.06	0.91	0.015	0.011	18.97	8.20	0.01	0.10	0.004	0.0298	0.0085

【0017】

【表2】

材質$^{(1)}$（伸び）	52.5	54.2	51.3	53.0	48.2	49.8	49.5	52.0	45.3	48.2	46.8	43.6	46.0
MnS数	○	○	○	○	○	○	○	○	×	×	○	×	○
介在物組成（重量％） MgO	4.3	3.8	4.5	4.8	4.1	3.7	2.6	4.1	21.5	27.7	3.7	15.3	4.1
Cr_2O_3	1.5	1.2	0.8	1.6	1.7	0.4	0.2	1.3	-	-	0.5	0.8	1.1
MnO	31.5	33.4	27.5	35.8	38.2	30.4	27.3	28.6	-	-	27.3	14.3	32.3
Al_2O_3	16.3	14.5	16.8	14.1	15.7	22.4	26.8	15.7	78.5	72.3	14.3	32.7	13.8
SiO_2	34.7	36.3	32.7	28.3	29.0	31.0	31.8	32.4	-	-	31.8	31.3	34.2
CaO	11.7	10.8	17.7	15.6	11.3	11.1	11.3	18.0	0	0	22.4	5.6	14.5
塩基度	1.50	0.90	1.70	1.15	1.60	1.85	1.95	1.60	3.5	3.3	1.7	2.6	1.4
Md_{30}	36.6	40.7	25.9	38.6	16.2	18.0	18.6	30.6	13.2	30.0	20.3	6.5	34.0
板厚（mm）	2.0	4.0	4.5	1.6	2.3	2.3	2.0	4.0	2.0	4.0	2.3	2.0	2.0
鋳造速度（m／min）	105	40	30	130	80	80	105	40	105	40	80	105	105
製造方法	VIM	VIM	PIM-AOD	PIM-AOD	PIM-AOD	PIM-AOD	PIM-AOD	AOD ダブルスラグ	VIM	VIM	AOD	AOD	AOD
	A	B	C	D	E	F	G	H	I	J	K	L	M
	本発明例								比較例				

【0018】表1および表2において、A～Hは本発明による例であり、I～Mは比較例である。比較材IはS量・介在物組成、比較材Jは介在物組成、比較材KはS量、比較材LはS量・Al量・介在物組成、比較材MはS量・Al量が、本発明の範囲を満たしていない。図1に、Md30値と伸びとの関係を示す。同一Md30値において、本発明による薄板は従来法による比較材に比べて伸びが3～4％向上していることが分かる。

【0019】図2（a）および（b）に、本発明のH材（伸び52％）と比較例のJ材（伸び48．2％）についてCMAによるMnS析出分布を示す。CMAでは円0．5μm以上の寸法のMnSが検出できる。本発明のH材は比較例のJ材とほぼ同等の組成（Md30値）であるが、粗大なMnSが多く、逆様的に考えれば粒成長を阻害する微細なMnSが少ない。これはH材の介在物組成がMnシリケート系であるのに対し、J材の介在物組成がAl_2O_3系であることによる。

【0020】図3に示すように、鋼中MnSはMnシリ

ケートを核として析出していることが分かる。各部位A、B、Cの組成は走査電子顕微鏡による薄膜分析による。図4に、介在物組成に及ぼすスラグ塩基度（CaO／SiO₂比）の影響を示す。この関係を利用して塩基度の調整により介在物組成を制御することができる。塩基度0．5〜2．5の範囲で、MnS析出核として適当な介在物組成が得られる。塩基度が0．5より小さくなると溶鋼中の酸素濃度が高くなり鋳片の清浄度が悪くなり、介在物起因によるメッキ性の悪化や耐錆性の低下が起こる。塩基度が2．5より大きくなると介在物がAl_2O_3−MgO系組成となり、MnSの析出核として不適当になる。

【0021】図5に、鋳造速度40m／min、105m／minの場合の鋳片表面の温度推移を示す。MnSの析出は、900℃以上での時間が長いほど更に有利になると考えられる。

【0022】

【発明の効果】以上説明したように、本発明によれば、従来低C化・低N化して鋼のMd30を調整して鋳造した方法に比較し、低S化と介在物組成の適正化によって、双ロール式連続鋳造における急冷凝固時にもMnSを粗大に析出させることにより、従来法に比較して高い伸び特性の優れたCr−Ni系ステンレス鋼薄板を安価にかつ安定して製造することができる。

【図面の簡単な説明】

【図1】Md30値と伸びとの関係を本発明材および比較材について示すグラフである。

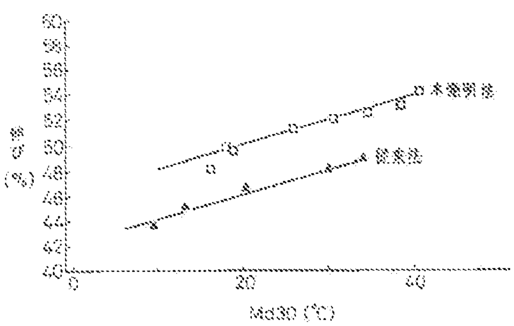
【図2】本発明材（a）および比較材（b）のMnS析出分布を示すCMA測定結果である。

【図3】鋼中MnSの析出形態を示す電子顕微鏡写真である。

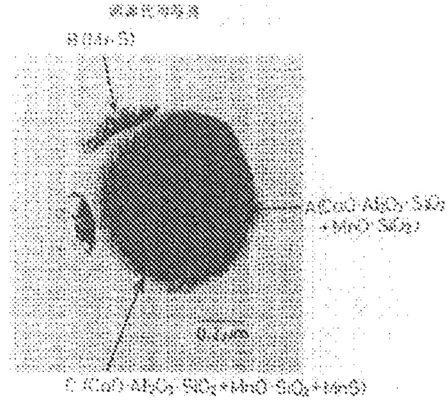
【図4】スラグ塩基度と介在物組成の関係を示すグラフである。

【図5】鋳片表面の温度推移を示すグラフである。

【図1】



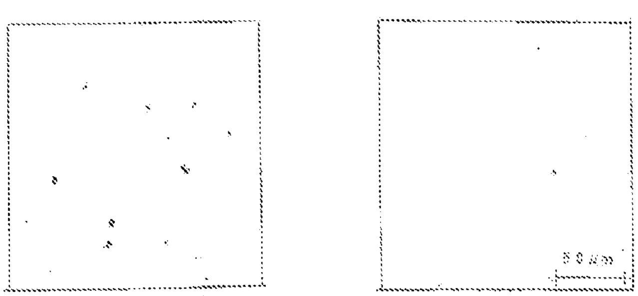
【図3】



写　真

【図2】

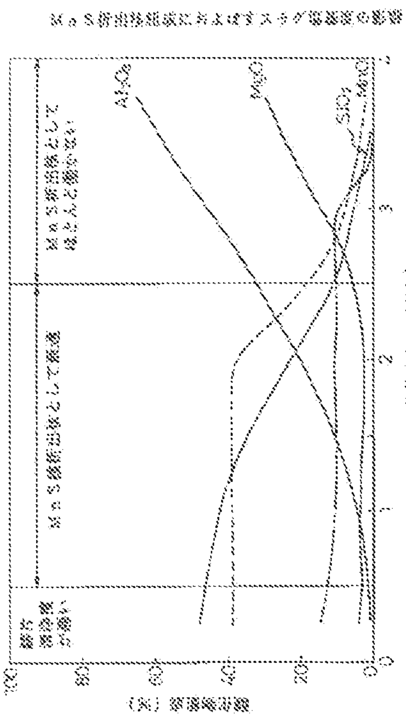
(a)　(b)



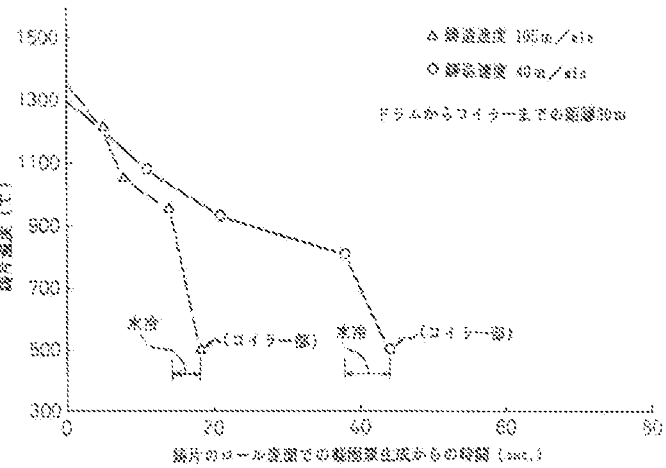
試料H（伸び52.0%）　試料J（伸び48.2%）

鋳片のMnS析出分布（CMA測定結果）
測定条件　ビーム1μm
照射電流1μA
照射時間30msec
測定面積400×400μm²

【図4】



【図5】



フロントページの続き

(72)発明者　桐原　端史
山口県光市大字島田3434番地　新日本製鐵
株式会社光製鐵所内